Inhaled Therapeutics using Dry Powder Inhalers (DPI)

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Abstract—Dry powder inhalers (DPIs), opposed to the traditional pre-metered dose inhalers (MDIs), prove to be more advantageous in delivering the desired dosage of medication to the targeted site. Now, engineers are designing better DPIs and new carrier particles that have better characteristics for drug delivery.

I. INTRODUCTION

Lung diseases usually occur from smoking, infections, and genetics. Once a patient is diagnosed with a disease such as asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, emphysema, acute bronchitis, or cystic fibrosis, effectively treating the lungs presents many difficulties. Usually, patients exhibit shortness of breath which derives from decreased lung function. [1] During moments of increased symptoms, patients have restricted inhalation and need medication to the area of inflammation. Dry powder inhalers are an alternative method to deliver highly dispersible dry particle conglomerates containing active medication. As the design of the device changes and the surface of the carrier particle is modified, the drug deposition significantly increases. Additionally, the device becomes more reliable and patients who need their prescribed medication are more likely to receive the correct dosage. [2]

II. METHODS

In a controlled trial conducted at Government Medical College Hospital, the ease of use of two inhalers, Autohaler and a traditional spaced MDI, were compared with patients ages 6 to 18 years of age. About 50 patients were included in this study. They each received the same medication [fluticasone (125 micrograms) plus salmeterol (25 micrograms) combination] but in different form, dry powder and mixed chemical propellant. Engineers predicted that the design of the Autohaler and its breath actuated function would significantly affect the ease of use and ability to administer the correct dosage. [2] http://www.mikesouth.org.au/Asthma_devices/MDIs/albuterol%20autohaler.html

After proving the effectiveness of the DPI device, engineers now focused on fine-tuning the dry powders to maximize drug deposition. Conventionally, companies used different powder formulations of lactose molecule carrier particles. An in-vitro studied was performed over-seas at multiple universities in London. Engineers tested three different blends of different grade coarse lactose supplement with different levels of fine lactose. Using three different DPIs Aeroliser, Handhaler, and Rotahaler, the different grades of lactose blends were tested for their in vitro particle distribution and drug deposition. The characteristics of blends, particle size and shape, was determined by using a Sympatec HELOS/Rodos laser diffraction unit. The different grades and blends were listed in a table. [3]

III. RESULTS

In the study involving the comparison of the Autohaler with metered dose inhaler, the patients using the breath actuated DPI (Autohaler) had better control of their asthma and received the desired dosage when needed with fewer dosage technical difficulties. The results were determined by clinical observation of dosing and personal medical diaries kept by either the patient or a legal guardian.

On another note, Engineers at the University of Hertfordshire concluded that drug particle dispersion in human lungs is majorly determined by the inhalation flow rate of the patient, the inhaler design, and the interactions between the drug and the coarse carrier particles. Specifically pertaining to their in-vitro studies, the amount of fine lactose added to the varying types of coarse lactose tended to increase fine particle fraction (FPF), which directly proved an increase in drug deposition in the lung.

(a) LH200 (b) ML001 (c) ML006

(white) Aeroliser (black) Handihaler (stripes) Rotahaler

IV. DISCUSSION

The combination of an easy to use effective dry powder inhaler device and a revolutionized dry powder carrier particle is currently changing the inhaled therapeutics market. DPIs are also making life a lot easier for patients who are burdened by common lung diseases and infections. The technology of both the device and carrier particles only advances over time. Companies such as Pulmatrix in Lexington, MA are in the process of developing completely different powder formulations with revolutionizing particle distribution and drug deposition characteristics. Instead of using lactose carrier molecules, they manufactured and branded their own calcium salt base powder titled iSPERSE™. [4] Pulmatrix has claimed iSPERSE™ as easily dispersible and a very dense particle, resulting in high yields of drug deposition in the target areas of compromised lung function. [5]
REFERENCES


